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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/615,057

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Tushar Prasad

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CONLEY ROSE, P.C.

P. O. BOX 3267

HOUSTON, TX 77253-3267

EXAMINER

GAKH, YELENA G

ART UNIT

PAPER NUMBER

1743

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS

01/17/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/615,057

Applicant(s)

PRASAD ET AL.

Examiner

Yelena G. Gakh, Ph.D.

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1743

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6, 15 and 16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6, 15 and 16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

1. Amendment filed on 11/16/06 is acknowledged. Claims 7-14 are cancelled. Claims 1-6 and 15-16 are pending in the application.

It appears that the IDS, which will be submitted by the Applicants later, will be considered as an After-Final submission. Corresponding requirements should be fulfilled.

Response to Amendment

2. In response to the amendment the examiner modifies rejections. Objection to the specification remains.

Specification

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. The specification is objected to as not containing "a written description of the invention ... in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains ... to make and use the same".

In particular, according to the Summary of Invention, "the present sensors exploit the superprism phenomenon, which causes a large deflection of a light beam in a photonic crystal when the incident angle of the light changes only slightly". From Detailed Description of the Preferred Embodiments it appears that creating such "superprism phenomenon" requires rigorous calculations including calculations of the band structure of the crystal, all possible values of wave vectors in 3D space, dispersion surface, input-output characteristics of any input ray, propagation direction, the largest non-linear response for the input ray (i.e. the largest variation in the output), etc. Only then it is possible to position the light source 30 and crystal 10 such that

the superprism effect of the crystal can be used to increase the sensitivity of the sensor in the composition of the solution. No particular calculations are provided in the Detailed Description or Examples, although “the results of these calculations are plotted [in] Figure 4” (page 8) (sic! “in” is missed from the sentence). It is not apparent, if the Applicants consider the calculations, which they just outlined in the specification, trivial. Moreover, it appears that the crystal can be used as a sensor only for a known analyte, when the analyte concentration changes.

The examiner considers the present specification inadequate to meet the enabling requirements for using photonic crystals as sensors the way it is claimed in the application.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-6 and 15-16 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The Breath of the Claims

The claims broadly recite a sensor for detecting the presence of an analyte in a solution, comprising “a photonic crystal containing the solution”, “a light source emitting a light beam at an angle to said photonic crystal” (the beam emitted by the light source will always be “at an angle” to the photonic crystal, with the angle ranging from 0° to 180°, *Ex.*), with the “light beam having a wavelength” (how the light beam may not have the wavelength? *Ex.*), and “a position sensing detector for detecting a change in the position of the light beam after the light beam is transmitted through said photonic crystal and the solution”. It is not quite clear, which change in the position is meant in the claim, since the change has to be measured relative to some reference value.

The Nature of the Invention

According to the specification the sensor is based on creating a superprism effect in the photonic crystal, which requires rigorous calculations and constructing corresponding photonic crystal. The disclosure is related to a purely theoretical model of such photonic crystals without any confirming experimental data. The language of the specification is suggestive, i.e. “once the internal propagation direction is determined, it is possible to compute the shift in the position of the transmitted ray if the geometry of the sample is specified [How can the *geometry of the sample* be specified? *Ex.*]. Using this information, it is possible to determine an optimum angle and frequency for an incoming light beam that can be used effectively to indicate changes in the photonic crystal. By way of the example, the magnitude of the beam displacement as a function of refractive index was calculated for two different incident angles and at several different wavelengths” (page 8). The example demonstrates a calculated theoretical sensitivity of the propagation angle of light in a photonic crystal, which is well known in the art as the “superprism effect” in the photonic crystals, see below.

The State of the Prior Art

The phenomenon of the “superprism effect” of photonic crystals, i.e. “high angular dispersion based on a rapid change of the group propagation angle with wavelength in a photonic crystal” (Gerken et al., Proceedings of the SPIE, 2005) is well known in the art, see e.g. Kosaka et al. “Superprism phenomena in photonic crystals: toward microscale lightwave circuits” (J. Lightwave Technology, 1999), Wu et al. “Superprism phenomena in photonic crystals (Physical Review B, 1998). Optical sensors based on changes of refractive indices in the samples containing various analytes, which determine the change of the effective index by change in the outcoupling angle measured by a photodiode array or position dependent photodetectors, are also well known, see Tiefenthaler et al. (US 4,815,843), especially col. 7, lines 31-44). “A further measuring method makes use of the relation between the angle of incidence θ_1 , at which optimum incoupling occurs, and the laser wavelength. In this measuring method the angle of incidence θ_1 remains constant and the wavelength of a tunable laser is changed in such a way that the intensity of the guided mode 8 maintains its maximum or, respectively, a constant value, while the effective index is changed by the influence of the sample 3. From the change of

wavelength the change of the effective index is determined” (col. 7, lines 9-20). Having “high angular dispersion based on a rapid change of the group propagation angle with wavelength in a photonic crystal”, it would have been obvious for any person of ordinary skill in the art to assume that optical sensor based on changes in refractive indices due to the presence of analytes would be most pronounced in photonic crystals possessing superprism effect. However, no experimental data are found in the prior art, which demonstrate application of such correlations of refractive indices to the nature and/or quantity of the analyte for superprism photonic crystals. The examiner assumes that this is related to a non-trivial task of finding such correlation and performing real experiments for real photonic crystals possessing superprism effects.

***The Level of One of Ordinary Skill and
The Amount of Direction Provided by the Inventor***

The specification does not provide an adequate disclosure for any person of ordinary skill in the art to construct the sensor recited in the claims, i.e. the sensor based on a specific photonic crystal possessing superprism effect, which would be capable of determining the presence of the analyte in the solution on the basis of changing angle of the output light beam. On the other hand, any change in refractive index of the crystal material will lead to change in this angle, whether this is an analyte or any unknown impurity in the solution. The disclosure is totally silent as to how the sensor would be capable of detecting the specific analyte in the solution vs. such impurities. Moreover, the construction of the sensor is based on very rigorous calculations not fully provided in the disclosure, which makes developing such sensor un-enabled to any person of ordinary skill in the art. Moreover, it appears that the crystal, even if can be somehow constructed, can work only for a specific solution, since the construction takes into account the refractive index of the solution (see page 5 of the specification).

The Existence of Working Examples

No working examples for the sensor recited in the claims are provided in the specification; the examples are related exclusively to a theoretical model of the photonic crystal possessing superprism effect. Moreover, the Applicants indicate that only partial calculations were performed for the instant application and that “the band structure must be calculated from Γ

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to all possible points on the surface of the Brillouin zone, rather than merely the high symmetric points". The disclosure does not lead to presumption that such calculations are trivial and well known for any person of ordinary skill in the art. Otherwise, the Applicants were expected to provide full calculations along with real experimental data for the claimed sensor.

***The Quantity of Experimentation Needed
to Make or Use the Invention Based on the Content of the Disclosure***

From all indicated above the examiner draws a conclusion that it would have been an unnecessary burden of experimentation for any practitioner in the art to practice the invention, taking into account its inadequate disclosure, which does not appear to enable the claimed sensor at the present state of the art.

Response to Arguments

6. Applicant's arguments with respect to the pending claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Yelena G. Gakh, Ph.D. whose telephone number is (571) 272-1257. The examiner can normally be reached on 9:30 am - 6:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jill A. Warden can be reached on (571) 272-1267. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

1/08/07



**YELENA GAKH
PRIMARY EXAMINER**